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The world reshaped: practices and impacts of early agrarian societies

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ABSTRACT

The contributions in this volume indicate that research into the study of early agriculture continues to remain a flourishing area of science. We discuss the contribution of the volume's papers and provide a review of how they add to our knowledge about the process to early agriculture, its development and impacts upon the Holocene landscape. The main focus of many of the papers is on the European Neolithic record, with several contributions focussing on research from other regions. Our understanding of the processes happening in Europe is deepening to a level where we have a relatively good understanding of events at a regional level and moving towards understanding at a continental level. This contrasts with other areas of the world where there is still considerable need for intensive primary data collection and where the narrative of agricultural subsistence practices varies considerably. In some regions, existing models of understanding may not be fully adequate and the process of "agriculture" in these areas was likely substantially different to how this occurred in Europe and the Near East. Indeed, it is clear that a more nuanced understanding of how we currently define 'agriculture' is necessary. This recognises the diversity of agricultural practises that are evident in different areas of the world, which may be quite removed to what might be recognisable as 'agriculture' in places such as Europe.

It is evident that the switch from hunter-gatherer subsistence to agro-pastoralism had a huge effect on the Earth system, impacting biodiversity, land cover and the global carbon cycle. Archaeologists have much to contribute towards our knowledge of these impacts and the development of the modern 'cultural landscape'.

1. Introduction

This volume of 20 papers emanates from two sessions that were run at the INQUA Bern Congress, in July 2011. The first session was convened by Walter Doerfler, Ingo Feeser, Wiebke Kirleis, Mara Weinelt (Graduate School of Human Development and Landscapes and Institute of Prehistoric and Protohistoric Archaeology, Kiel University), and Felix Bittman (Lower Saxonian Institute for Historic Coastal Research, Wilhelmshaven) entitled '*Climate, Environment and Economy in the north and central European Neolithic*', whilst the second was organised by Nicki Whitehouse, Chris Hunt (then Palaeoecology Centre, Queen's University Belfast), Rob Marchant (Dept of the Environment, University of York), and Carsten Lemmen (Helmholtz-Zentrum Geesthacht) entitled '*The world reshaped: mechanisms and impacts of agricultural transitions*'.

The research papers brought together here operate at four different scales: (i) site specific investigations; (ii) intra-site analyses; (iii) regional syntheses and (iv) continental modelling applications that are contrasted with regional case studies. The modelling approaches have the potential to stimulate wider archaeological perspectives on the practices and impacts of early agrarian societies. However, model-based simulations must be evaluated and tested against empirical data from the regional case studies and syntheses. As syntheses generate larger data sets, the scale of regional and supra-regional human–environment interactions become clearer. The importance of the detailed site and intra-site investigation that the syntheses are based upon, however, remain highly relevant in generating fundamental knowledge and understanding. These site and intra-site investigations

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are critical to the over-arching approaches that we consider to be the next steps in our understanding of the diachronic and socio-spatial changes associated with this period. The diverse range of papers from Europe presented in this volume demonstrates the importance and detail afforded by a range of spatio-temporal perspectives provided by many contributions in the volume. This contrasts with many other areas of the world (e.g. Asia, Africa, S. America) where there is still considerable need for intensive primary data collection on the different scales we have highlighted and where the narrative of agricultural subsistence practices varies considerably.

In Europe, the transition between the Mesolithic and Neolithic is generally defined by the occurrence of several Neolithic elements: the so-called 'Neolithic package'. These include the presence of cereals, animal husbandry, pottery, polished stone axes and permanent settlements. On-going research, however, suggests that there may have been a considerable chronological offset between the first occurrence and the widespread establishment of elements of the Neolithic package (Colledge et al. 2005). Thus, different kinds of transitional processes, trajectories and ecological influences accompanied the development and establishment of early agro-pastoralist societies throughout the Neolithic and across different regions (Tresset and Vigne, 2007; Jones et al. 2013a; Manning et al. 2013). Advances in techniques such as stable isotope research, biomolecular archaeology and molecular genetics (Schulting and Richards, 2002; Larson et al. 2007; Schulting et al. 2010; Jones et al. 2012; Krause-Kyora et al. 2013) are providing useful insights onto the spread of cultivars and domesticated animals across Eurasia. What sorts of landscapes and environments were created as a result of the transition to agro-pastoralism and what were the differing impacts to the environment? How did these transitions feed back into determining the nature of human–environmental interactions? It is evident that the switch from hunter-gatherer subsistence to agro-pastoralism had a huge effect on the Earth system, impacting biodiversity, land cover and the global carbon cycle (Kaplan et al. 2010; Ellis et al. 2013), although there is still debate as to when these processes became critical in terms of their effects (Seddon et al., 2014). However, human–environment interactions did not necessarily have negative effects on ecosystems and biodiversity. In the long run, for instance, woodland openings and the establishment of arable fields in Europe created many new habitats for plants and animals that in turn led to increases in the biodiversity of weed species (Willerding, 1986), the creation of many iconic cultural European landscapes (Grove and Rackham, 2001) and advantaged many other taxa such as saproxylic invertebrates, many of which flourish in open forest habitats (Whitehouse and Smith, 2010; Horak et al. 2014).

The transition to agriculture led to substantial changes in the way humans interacted with their environment. The causal factors behind these subsistence changes in the different founder regions remain hotly debated and were influenced by local and regional effects (Barker, 2006); this is especially the case in terms of the choices of particular crops and how these are suited to given environments. The techniques used in early cultivation remain a matter of debate, with some scholars advocating slash and burn agriculture, whilst others have argued for small plot, intensive, 'garden' agriculture (Bogaard and Jones, 2007; Bogaard, 2004; Huisman and Raemaekers, 2014; Rösch et al. 2014; Saqalli et al. 2014). It is important to remember that Neolithisation did not happen at the same time for Europe as a whole (Schier, 2009), with some areas of northern Europe significantly delayed in terms of their transition to agriculture (Rowley-Conwy, 2011; Müller, 2011b; Bakker et al., 2013; Bakels, 2014), for reasons that are not entirely clear. In these areas, agriculturalists and hunter-gatherers apparently lived in close proximity to each other (Rowley-Conwy, 2004; Sørensen and Karg, 2014), leading to significant debates within the literature about the nature of their interactions (e.g. Zvelebil, 1996, 1998, 2005; Rowley-Conwy, 2011). Nevertheless, we now have a reasonably good understanding of the events in Europe, as we discuss below. However, it is by no means certain that the West Asian/European transition model is appropriate globally, particularly in the Far East and Africa, where there are very different patterns of early plant use. In turn, research in these other locations have highlighted problems with our definitions of agriculturalists and hunter-gatherers that offer useful lessons for our understanding of the past (cf. Harris, 1989) in the well-studied areas of Europe and the Middle East.

The European concept of agriculture – both in terms of the process of 'becoming agricultural' – and everything this implies – as well as the definition of agriculture itself, is not necessarily transferable to the tropical parts of the world. The process of subsistence economy in different parts of the world is much less well understood and appears to have followed a less clear pattern of intensification and increasing specialisation, focused on a relatively limited set of cultivars and domesticated animals, as we see in Europe. As several of our volume contributors argue (cf. Hunt and Rabett, 2014), the process of "agriculture" in these tropical areas was substantially different and has led to a more nuanced understanding of how we define agriculture (Fairbairn, 2005, cf. Summerhayes et al. 2010; Jones et al. 2013b). Even in Europe, where the process of becoming agricultural has been studied for almost a century, there are unexpected surprises, as we discuss below.

Thus, how we define and characterise 'agriculturalists' and 'hunter-gatherers' remains enormously problematic in many areas of the world, since descriptions often fail to convey the richness and complexity of subsistence practises (Denham, 2007). For instance, plant exploitation in regions such as New Guinea was hugely varied, both in the recent past and in the archaeological record. Island South-East Asia's inhabitants were active agents in the development of their early farming activities and successfully adopted and integrated new plants and husbandry practises into their existing subsistence activities (Denham, 2013). This included the use of hybridised cultivars from south-east Asia, whilst other in-coming staples were domesticated within New Guinea and surrounding regions. Many trees were also domesticated within this region, although the processes and timing associated with these are uncertain (Denham, 2007). There are strong similarities between the archaeobotanical record of tree products from New Guinea and Australia, yet whilst the latter are recognised as being associated with 'agriculturalists,' in Australia these records are viewed as being associated with the activities of 'hunter-gatherers' – because Australian Aborigines have been defined as such (Denham, 2007, 248). Existing definitions often drive how groups are categorised, leading to interpretations that might be at odds with the data. These issues of definition are intensively discussed in the compilation of case studies brought together under the umbrella of "Rethinking agriculture" by Denham et al. (2009).

2. Transitioning towards agriculture and early agricultural dynamics

The nature of agro-pastoralism in central, northern and north-west Europe is now relatively well understood and is particularly well represented by papers within the volume. These indicate that it is now possible to recognise some general characteristics surrounding agriculture and associated social practices that are relevant to the early Neolithic as a whole, whilst recognising the considerable environmental and social diversity evident within the

records too. For instance, quantitative reconstructions of the regional vegetation cover for Northern Germany and Denmark using the REVEALS pollen model of Sugita (2007) shows that this region had a relatively more open landscape compared with central Germany and eastern Denmark during the Neolithic (Nielsen and Odgaard, 2010). Establishment of an agricultural lifestyle is observable throughout the region, with the first landscape openings at around 4100 cal BC in central Europe, followed by an intensification of land use, possibly due to technical innovation taking place about 400 yrs later (Rasmussen, 2005; Dörfler et al. 2012; Feeser et al. 2012). In the Funnel Beaker Culture (FBC) region of the Northern European Plain, the first macrofossil evidence for cereal cultivation (cf. Kirleis et al., 2012) coincides with the beginnings of a widescale, supra-regional opening of the landscape (Kirleis and Fischer, 2014).

Sørensen and Karg (2014), argue for a rapid spread of agriculture from central Europe, towards Denmark — within 300 years (4000–3700 cal BC) — based on new radiocarbon dates. This was prompted by migration of small groups of pioneering farmers from central Europe that were settling around easy accessible inland flint mines in regions with easily-worked arable soils. In contrast, contemporaneous coastal and lake-shore sites in Denmark show a gradual establishment of agrarian subsistence by local communities. Sørensen and Karg (2014) thus interpret the Neolithisation of Denmark as a complex and continuous process of migration, integration and gradual assimilation between pioneering farmers and local hunter-gatherers. Their interpretation is supported by recent genetic evidence from ancient pig bones that demonstrate that Mesolithic Ertebølle hunter-gatherers made use of domestic pigs of similar lineages to those of their agricultural neighbours (Krause-Kyora et al. 2013). This implies cultural interaction between agricultural and hunter-gatherer communities in northern Europe, suggesting a complex process of integration and assimilation over this period. Further north, in southern Norway, we also see a gradual transition towards the beginning of farming, an event that is neither marked by extreme woodland opening or by intensive cereal cultivation, as in the coastal areas hunting and gathering still played an important role in economy (Glørstad, 2010; Wieckowska et al., in press).

This gradual transition in Scandinavia contrasts with northern-western Europe where the start of agriculture begins, apparently abruptly, about 3900–3800 cal BC (Whittle et al. 2011; McClatchie et al., 2014). This apparent rapid transition may, however, in part be a product of the precision of the radiocarbon method and the chronology building process, rather than a transition that might have been viewed as 'abrupt' by the people involved. Nevertheless, when contrasted with the timings elsewhere across Europe, the move towards agriculture in Britain and Ireland seems to have been more rapid than in other areas. Why this should be the case, at this particular time, is a matter that has not received particular research attention. In Britain, there is no evidence for cultivars prior to 4000 cal BC, with only very limited evidence of cultivation from 3950 to 3800 cal BC, and a marked increase from 3800 cal BC (Brown, 2007; Whittle et al. 2011). Whittle et al.'s (2011) re-evaluation of the British Neolithic suggests a start between 4050–3900 cal BC in southern England, but it's really not until 3800 that there is good evidence for major expansion of farming across England. The Neolithic in Scotland and Ireland dates to slightly later still; an abrupt transition towards agriculture in Ireland is indicated from 3750 cal BC onwards (Whitehouse et al., 2014), with agricultural crops common on many different sites, but particularly at the early Neolithic rectangular house structures that are common across Ireland at this time (Smyth, 2010). McClatchie et al. (2014) provide a comprehensive synthesis of Neolithic plant remains from Ireland via an analysis of published and unpublished 'grey' literature. The arable weed assemblages suggest fixed-plot, intensive agriculture, perhaps akin to garden plots, and there are no indications of the use of a shifting cultivation regime, in common with research from Neolithic Britain (Bogaard and Jones, 2007) and elsewhere in central Europe (cf. Bogaard, 2004). Emmer wheat was the dominant crop, and other crops included naked and hulled barley, naked wheat, einkorn wheat and flax. The latter is particularly surprising, as flax is not apparently present in the contemporaneous southern Scandinavian and northern central European Neolithic – possibly due to poor preservation conditions – although it is present within the British Neolithic record, at several sites in England and Scotland (Pelling and Campbell, 2013). Flax may suggest connections towards the western European Neolithic, where it is seen for example in Belgium during the LBK (Salavert, 2011; Bakels, 2014).

How did the cultivation plots manage to remain productive over long periods, in the absence of shifting cultivation practises that might have assisted with maintaining crop productivity? Stable isotopes of cereals have proved insightful for examining prehistoric cultivation and manuring practises (cf. Bogaard et al. 2007; Fraser et al. 2011). Kanstrup et al.'s (2014) important paper discusses isotopic compositions (**d**13C, **d**15N) of charred grains of naked barley, emmer and spelt dating to between the 4th and 1st millennium BC from Denmark, as a proxy for crop manuring. These data represent one of the most comprehensive investigations of long-term trends in **d**15N values, inferred to represent manuring activities, from charred cereal grains in Europe. The work indicates that manuring was an important practice throughout the chronological period under investigation. Changes in manuring practices were also detected across different crop types, with long-term decreasing manuring intensity found with the cultivation of emmer (3900–500 BC), in contrast to trends associated with naked barley (2300 cal BC–cal AD 1). Naked barley displays a distinct and significant increase in nitrogen values, perhaps associated with intensive and systematic manuring of this crop during the Early Iron age. It seems evident that manuring practices were important from the earliest phases of agriculture in Denmark and that over time manuring likely increased, as agricultural practices intensified (Kanstrup et al., 2014).

Bakels (2014) contrasts the rather late introduction of crop growing in the North-western European Plain compared with the central European loess belt, where farming started around 5500 cal BC (Kreuz, 2012; Gronenborn et al., 2014; Salavert et al., 2014). Crop types are, of course, influenced by geographical and climatic conditions, but availability and social aspects also affect preferences and decision processes associated with the choice of crop plants used. We thus see a progressive loss of founder crops as agriculture spread from south-east to north-west Europe (Kreuz et al. 2005; Shennan and Conolly, 2007; Connolly et al. 2008). The decline in founder crops becomes even more evident into north-west Europe and its margins. McClatchie et al. (2014, Fig. 7) and Kirleis et al. (2012, Fig. 4) demonstrate the further loss of cultivar types, such as pulses, by the time agricultural practices arrive in the North European plain, southern Scandinavia, Britain and Ireland, when compared with central Europe. This latter point suggests that the availability of protein from other sources such as animals (e.g. via meat, milk, cheese) may have been critical in some areas of northern Europe. This is evidenced via new research based on lipids derived from pottery vessels (Cramp et al. 2014) that shows that milk proteins were important constituents of the Neolithic diets in these areas.

Bakels (2014) also points out that we still know rather little about the nature of fields used in early agriculture and that the cultivation techniques are not yet fully understood. Opening of the landscape, via forest clearance, must have been one pre-condition

for technological innovations like the introduction of the ard and the wagon. The latter has a polycentric origin. For example, it was introduced in the mid of the 4th millennium BC in Uruk, Mesopotamia, in the northern Pontic region, in the Hungarian Danube region, as well in northern Germany (Bakker et al., 1999; Schlichtherle, 2002; Mischka, 2013). The associated pronounced woodland openings and the stepwise establishment of agriculture are revealed within many pollen records. In particular, those from yearly laminated lake sequences, which enable well-resolved temporal resolution of the records, are highly suitable for connecting with the archaeological record (Feeser et al., 2012). The benefits of such interdisciplinary approaches to pollen and archaeology are well demonstrated by the research programme at Kiel University on "Early Monumentality and Social Differentiation" (Müller et al., 2013). Initial results depict many changes around 3650 cal BC within both the social and environmental spheres, when the Funnel Beaker Culture (FBC) entered a "megalithic phase" with newly emerging burial rituals, whilst changes in the subsistence regime are observed (Müller, 2011a; Müller et al., 2013). This phase coincides with the introduction of the ard, expansion of field systems and a reduction of species in the cereal assemblage (Müller, 2011b; Kirleis and Fischer, 2014). At the end of the 3rd millennium BC, a short phase of woodland regeneration is linked to a decline in human activity following a climatic deterioration indicating wetter conditions (Dreibrodt et al., 2012). Later changes coincide with the cultural transition towards Single Grave Culture around 2800 cal BC (Feeser et al., 2012).

Relationships between agricultural activities and population levels are explored by Woodbridge et al. (2014b). Using a pseudo-biomisation approach to examine land-cover change and population fluctuations derived from radiocarbon probability density functions from Britain, the authors investigate drivers of landscape change. Early Neolithic population growth is evident in the radiocarbon data, in the form of increased probability densities accompanied by significant impacts on woodland cover. Between 3300 and 2400 cal BC, a reduction in the probability record is signalled, together with evidence for woodland regeneration, whilst between 2400 and 1400 cal BC, late Neolithic woodland clearance coincides with further population increases, which continued into the early Bronze Age. The authors consider that these population patterns are likely driven by endogenous factors, rather than climatic changes.

Some of these events show similarities with records from Ireland. Whitehouse et al. (2014) provide a Bayesian re-evaluation of the chronology of Irish Neolithic agriculture. The authors outline results of more than 800 radiocarbon dates, of which 187 are new AMS determinations. Patterns of expansion and contraction of populations and agricultural activities similar to Britain are also evident (Whitehouse et al., 2014), starting with an abrupt transition to agriculture around 3750 cal BC and linked to an expansion of Neolithic rectangular house structures (Smyth, 2010). Between 3300–3000 cal BC, they observe a decline in settlement evidence – perhaps related to a population decline or change in domestic architecture that coincides with a period of afforestation in the pollen record, decrease in evidence for crop growing activities and an increase in the frequency of wild fruits within the record. Hinz et al. (2012) argue for a similar population decline c. 3350–3100 cal BC at Funnel Beaker sites in Northern Central Europe and Southern Scandinavia whilst several other European records suggest a period of uncertainty (Schibler and Jacomet, 2010; Tallavaara and Seppä, 2012; Crombé and Robinson, 2014). Whitehouse et al. (2014) argue that these changes in settlement and population behaviour in the Middle Neolithic may be related to a shift towards more regionalised behaviours and to a greater mixture of mobile and settled existence – at least in Ireland and Britain – that may be related to changing social relationships as well as the inherent difficulties of crop production in the wet climates of northern Europe. A peak in Irish passage tomb construction at this time attests to changing social and ideological structures and the prominence of certain places in the landscape (McLaughlin et al., submitted for publication). Nevertheless, a number of records from across north-west Europe emphasise environmental changes between 3500/3300–3000 cal BC, suggesting that communities may have also have modified aspects of behaviour in the light of climatic uncertainties and potential difficulties in crop production.

However, as the work of Lemmen and Wirtz (2014) indicates, although climate variability may mediate some cultural factors, it does not appear to trigger or cause the Neolithic transition in Europe. Lemmen and Wirtz's (2014) mathematical model simulates the Early Neolithic transition for western Eurasia (7000–3500 cal BC) on a super-regional scale to explore its sensitivity to climate extremes. A correlation of regional socio-cultural developments with climate extremes identified in palaeoecological records serves as the backbone for the model. High variability in the timing of the spread of the Neolithic, including hiatus phases and rapid spreads are observed. The integration of climatic extremes into the model improved the fit of the model with data on the Neolithic transition. However, from a statistical point of view, the simulation suggests that climate extremes were not significant drivers for the Early Neolithic transition in Europe. The authors conclude that agency and endogenous socio-technological factors likely dominated past societal dynamics more than climate change.

One way of exploring the connections between agricultural history and climatic change is offered by Gronenborn et al. (2014), who apply a model from resilience theory to archaeological data for the Early Neolithic Linear Pottery Culture in west-central Europe. Resilience theory focuses on the cyclicity of developments within ecosystems and the identification of threshold levels. Here, ceramic typologies and dendrochronological tie points create a unifying archaeological chronology for the study region. Palaeoclimatic proxies are used to identify periods of increased vulnerability and social complexity of LBK societies. In this paper, a dependency of LBK-societies on weather conditions, in particular the varying amounts of precipitation, are the main arguments presented for explaining population dynamics and social change. However, the LBK-chronologies require refinement, with the ^{14}C-plateau (5500–5200 cal BC) causing severe problems of resolution. Future research on LBK-chronologies will hopefully demonstrate the relevance of the resilience model. However, whether resilience theory is capable of fully explaining how human societies behave is a moot point, which possibly underestimates the effects of social action and cognitive power of humans versus the effects of environmental and climate change.

3. Linking ritual and domestic spaces

Several papers in the volume explore the relationships between ritual and subsistence activities, and the use of landscape spaces by early agriculturalists. Lee et al. (2014) explore the importance of burials in maintaining identities and links across different groups. The authors present the genetic evidence associated with later Neolithic agro-pastoralists in Germany and emphasise the lack of data associated with populations that had already fully adapted to the new agrarian lifestyles (3600–2200 cal BC). Using four later Neolithic burial sites in Germany, they discuss the genetic evidence associated with large-scale collective burials and monumental architecture and explore the genetic relationships between the different burial groups. The haplotypes suggest that shared genetic groups may have shaped the arrangement of the deceased within

later Neolithic agricultural groups, and that monumental burials may have played an important role in maintaining common linkages across groups. Potentially, this might signify the development of strong identities within these groups, perhaps the consequence of increased importance and meaning of territoriality and/or ownership of lands, as a result of agricultural activities. Bogaard et al. (2011) demonstrate how plant husbandry likely played central roles in the development of social identities in these early farming communities; its probable such identities strengthened with increased ties to the land and territories that must have been inevitable with the development of agriculture.

A comparison between pollen data and the distribution of monuments, settlements and material culture by Feeser and Furholt (2014) investigates the relationship between ritual and subsistence activities, focussing on the late Funnel Beaker (3500–2900 cal BC) and Single Grave periods (2900–2200 cal BC) in northern Germany. High values for variables relating to ritual activities are strongly associated with anthropogenic landscape clearance during the megalithic period (3500–3100 cal BC), whilst during the Single Grave Period, relationships between the proxies investigated became more diverse and complex. In the eastern areas, declining burial activities were accompanied by a decline in agricultural and open pollen indicators, but in western areas, there seem to be less strong relationships between agriculture and burial activities. These regional differences suggest varying local levels of intensity and identity within ritual and economic spheres over the study periods. These are related to a stable socio-economic system in eastern areas that was apparently less open to the adoption of innovations and new ideologies. In contrast, in the western areas, Funnel Beaker groups had apparently less intensive economic activities, weaker relationships between ritual and economic activities and were more open to ritual innovations emerging after 2900 cal BC. Palaeoecological investigations by Sadovnik et al. (2014), indicate that, generally, burial sites were isolated from settlement sites and centres of agricultural activity, but were often located within a wooded landscape. Their conclusion is based on an investigation of prehistoric forest use and human activities associated with local megalithic graves at Krähenberg, northern Germany.

The links between woodland resources and stone monument construction are also explored by Farrell et al. (2014). Here, the authors discuss connections between deforestation and the importance of stone built monuments in Neolithic Orkney. The islands have long been assumed to have been essentially treeless throughout the Holocene. A study of new Orkadian pollen sequences and re-evaluation of existing data, however, suggests that the timing of woodland decline was not synchronous. It began in the Mesolithic, but in some areas woodland persisted into the Bronze Age. Farrell et al. (2014) suggest that a wider range of woodland resources was available to Neolithic people than previously assumed and that the predominance of stone architecture on the islands may not have been due to lack of timber, as previously believed. Indeed, recent archaeological material attests to the use of timber buildings during the early Neolithic. Farrell et al. (2014) therefore conclude that the shift to stone construction, from the use of timber, in Neolithic Orkney may have been influenced by a combination of social, cultural and environmental factors.

The benefit of interdisciplinary work is demonstrated by Brozio et al. (2014), who look at the study of domestic and ritual spheres. Here, deposition practices in a Middle Neolithic well (c. 3050 cal BC), at Oldenburg-Dannau LA77 (North Germany), from the FBC North Group, are reconstructed in detail. The unusual context of the Neolithic well implies that Middle Neolithic communities in this area were concerned with water management strategies and ensuring clean water supplies. There seems to have been a wider trend for the construction of wells, coinciding with the introduction of the ard and the construction of megalithic tombs and enclosures. Within the well were an abundance of crop processing residues and weed assemblages. These indicate summer grown crops whilst perennial taxa suggest crop cultivation made extensive use of the ard. Wild plants such as crab apple, which appear to have been dried for later consumption and other weed taxa emphasise the continuing importance of the use of wild plants at this time. Apple remains are known in the prehistoric archaeological record, including old apple halves from several Swiss Neolithic and Bronze Age sites (Schlumbaum et al. 2011). Brozio et al. (2014) argue that fruit trees such as apples were likely managed. Subsequently, the well was in-filled with domestic refuse, including numerous broken grinding stones and ceramics, perhaps forming an intentional process of ritual destruction.

4. Wild foods

The importance of wild plants and animals within the Neolithic is an important theme in many of the papers in the volume. There has been a long-standing debate in north-western Europe about whether Neolithic societies were mobile and whether cereals and domesticated animals formed a major or minor component of the Neolithic diet (cf. Thomas, 1999, 2004). Researchers have stressed the importance of wild plants in Neolithic Britain (Moffett et al. 1989), especially hazelnuts, as well as various fruits including wild crab apple, sloe, blackberry/raspberry, hawthorn and tubers (Robinson, 2000) and that wild foods are frequently better represented than cereal grains and crop waste (Stevens and Fuller, 2012). This, together with the limited evidence for house structures or settlements at this time has led to an emphasis on mobile communities, dependent on wild resources, rather than domesticated ones (Thomas, 2004). Part of the issue is taphonomic, as Jones (2000) has emphasised; cereal remains are much less visible in the archaeological record, compared with hazelnuts and other wild fruits since their recovery is dependent upon accidental charring episodes and are less noticeable compared with other macro-remains. Several papers in the volume highlight the continuing importance of wild species in the Neolithic, but also that their importance is temporally more complex than previously appreciated.

McClatchie et al. (2014), for instance, indicates that whilst wild plant remains persisted during the early stages of the Irish Neolithic, alongside cereals and permanent houses, some varieties (e.g. fruits) appear to have become more prominent in records during the Middle Neolithic. This means that wild plants remain important alongside cereals during the early stages of the Neolithic, at a time when we have abundant evidence for sedentism. It is unlikely, therefore, that these communities were mobile but clearly made use of a variety of resources, including wild species. During the Middle Neolithic, however, cereals appear less frequently in the archaeological record, alongside increases in some wild plant remains, although as McClatchie et al. (2014) point out, the former could be taphonomically driven. Similarly, Bishop et al. (2009) also note the increasing use of wild plants in Scotland around a similar time, c. 3300 cal BC, alongside a significant increase in the utilisation of barley, a crop more tolerant of cooler, wetter conditions, and a decrease in wheat use in southern and north-east Scotland. Bishop et al. (2009) suggest this may be due to responses to increased risk of crop failure and worsening growing conditions for wheat during the later 4th millennium BC. What we do see, therefore, is that wild varieties of plants were important throughout the Neolithic, alongside the use of cultivars, but that the improved chronological modelling associated with the Neolithic

Irish data indicates that there is a temporal trend to these findings. The Scottish work of Bishop et al. (2009) also suggests a geographical pattern, indicating that changes in crop types and uses of wild plants may have been, at least in part, associated with a system of diversification during periods of uncertainty of crop production. It is also clear that varying types of plants may have been used in different cultural contexts. Kirleis et al. (2012) emphasise the importance of diverse types of plant assemblages depending on archaeological context and site type, showing that different spheres of plant use (economic and ritual) can be observed for the Funnel Beaker Culture (FBC). Here, domestic sites allow for insight into past economy whereas spectra dominated by wild plants are observed at tomb sites. Such approaches reveal the uses of integrating across diverse lines of archaeological evidence but also emphasise that wild plant foods continue to remain important over this period.

The collection of wild plants and especially fruits is likely to have been facilitated as the woodland landscape opened up as a consequence of the development of agriculture. Charcoal analyses from archaeological sites are an often-overlooked method to improve our understanding of the degree of woodland openness and woodland use in the past. Salavert et al. (2014) present local to regional scale charcoal analyses from seven LBK-sites. Two stages of settlement can be identified in the charcoal record for the LBK in eastern-central Belgium. Initially, LBK groups fragmented the dense natural woodland cover and reshaped their local environments. They then established new habitats that favoured heliophilous species and shrubs. Whether by accident or by design, these forest edge habitats served as 'fruit gardens' to facilitate the gathering of semi-wild plants like wild apples and the collection of firewood. Similarly, Jansen and Nelle (2014) provide an insight into the nature of woodlands associated with six Funnel Beaker sites, based on the analysis of wood charcoal. Each site reflects nearby forest composition during the Neolithic, whilst the impacts of human activities on the landscape are also evident within the assemblages. Thus, we see that light demanding species such as *Corylus* and Maloideae show high values, indicating the opening up of the forests by Neolithic farmers at most of the sites studied. Comparison between wood charcoal and pollen assemblages at several sites where these are available show complimentary stories and strengthens interpretations from either proxy.

5. Alternative models of agriculture

It is abundantly clear that the agricultural transition led to substantial changes in the way humans interacted with food, its procurement and their environment in Europe. As we summarise above, we now have a reasonably good understanding of the events in northern and central Europe. However, it is by no means certain that the West Asian/European transition model is appropriate globally, particularly in Asia, Africa and south America where very different patterns have been observed. As Hunt and Rabbett (2014) discuss many ideas around the Neolithic in different parts of the world have been strongly influenced by our understanding of European prehistory and tend to be seen 'through the lens of a Eurocentric group of concepts and assumptions'.

Jin et al. (2014) discuss the significance of 8000 year-old rice remains from Xihe in the Shandong Highlands, eastern China. Systematic sieving and sampling of plant and animal remains on site showed that the occupants relied on fishing, hunting and gathering for their subsistence. However, rice remains dominated the archaeobotanical remains from the site, providing important evidence for Neolithic usage of rice in eastern Asia at this time. These remains are located significantly far beyond the geographic area traditionally known for the origins of rice cultivation but it is unclear whether the rice was wild, cultivated or domesticated, based on morphology, as there were no spikelet remains, which are the most secure means of identifying domesticated grains. The site is outside the known modern catchment area for wild rice. Although it is possible that in the past wild rice might have extended into other areas, there is no palaeoecological evidence to support such an assumption. The recovery of rice from Xihe thus represents a significant finding in terms of our understanding of early rice exploitation in China and emphasises the importance of rice as a food source in this region dating back 8000 years, alongside fishing, hunting and gathering.

The theme of rice cultivation continues with the contribution by Weisskopf et al. (2014). Their paper focuses on using modern analogue phytolith assemblages of associated crop weeds from Indian rice stands to develop a tool to differentiate between three types of cultivation systems with different ecological traits. The results of samples from modern fields demonstrate that phytolith assemblages show a positive correlation with different rice cultivation regimes, with wetness conditions being an important driving factor. The use of this approach is demonstrated for Neolithic sites in China and India. Differentiation of archaeological regions and periods can be separated through identification of a) wetland cultivation systems b) dry millet-dominated cultivation systems, in particular in North China, and c) rainfed/dry rice cultivation in Neolithic India.

Differences in agricultural approaches are explored within the contribution by Hunt and Rabbett (2014) who question whether the concept of a 'Neolithisation' is appropriate for areas of mainland and island SE Asia. The authors argue that this concept has been driven by European-influenced Neolithic models, which suggest that a diaspora of rice-growing agriculturalists from Taiwan some ~4200 years ago was responsible for the spread of farming in this region (known as the 'Austronesian Hypothesis'; Bellwood, 2005; Spriggs, 2011). Instead, they suggest that other models should considered, including indigenous inception of plant food production and exchange of plants, animals, technology and people as the prime mechanisms associated with the development of early agriculture in this region. The authors review the evidence for widespread forest disturbance during the Early Holocene and conclude that incipient and developing management of the rainforest vegetation for the production of food plants is observable in records from the early Holocene in Borneo. This is evident from plant biomass burning records, pollen evidence for disturbance, pollen of sago palm and rice phytoliths that persist for several thousand years at Loagan Bunut, implying a long-lived and stable system of land management for food production (Hunt and Rabbett, 2014). These practices differ to the plant food production systems (e.g. rice cultivation) developing in other more temperate regions of Asia and did not replace hunting and gathering practices, but rather accompanied them. Hunt and Rabbett (2014) argue that these food production relationships were often complex, locally contingent and did not result in the development of agricultural systems that would be in any way recognisable to early European contacts. They question whether the current 'Austronesian Hypothesis' is hugely relevant for this region and that the Eurocentric view of agriculture, based on a limited set of crops and animal domesticates, is clearly inappropriate for these tropical regions. Moreover, it is clear that human activities have played a key role in determining the current diversity and complexity of these tropical ecosystems. It's often assumed that tropical rainforest is the product of natural ecological, climatic and biogeographic processes and that people living in rainforest areas caused little change to vegetation. Hunt and Rabbett (2014) argue that this conception is flawed and even suggest that tropical forests are, to some extent, a cultural artifact.

An excellent example of whether some tropical forests have been culturally determined can be seen in the Amazon, which has been the focus of debate about human manipulation of tropical environments (Denevan, 2003; Willis and Birks, 2006; McMichael et al., 2014; Carson et al., 2014). Mayle and Iriante (2014) discuss the advantages of an integrated palaeoecological and archaeological approach for understanding pre-Columbian tropical ecosystems in Amazonia. They provide evidence to show that the scale of human impact on these tropical ecosystems was significant and discuss data showing how societies actively transformed the Amazonian landscape, over an extensive geographical scale. The scale of activities and the levels of cultural complexity are now being revealed via diverse archaeological records (e.g. '*terra preta*' soils, raised fields, large habitation mounds, megalithic monuments). Moreover, it is clear that the tropical forest biodiversity in these systems may be the product of centuries or millennia of human activities (e.g. Schaan, 2012). This has major implications in terms of our understanding of the biodiversity and ecosystem functioning of the Amazon, whether these systems are susceptible or resilient to anthropogenic disturbance and what the long-term consequences of human impact activities may be on these ecosystems. Mayle and Iriante (2014) stress that there remains considerable uncertainty over the chronology of the archaeological cultures, their subsistence practises and the scale of land usage and how far these map onto palaeoecological records of disturbance. Careful pairing of these records can provide a valuable tool for investigating how cultural activities have shaped the modern landscape and can offer important lessons for sustainable practices that have much relevance for similar seasonally-flooded savannah landscapes today.

The theme of sustainable agriculture continues in the paper by Marchant and Lane (2014). These authors discuss how East African ecosystems are shaped by long-term socio-ecological interactions, within the context of a dynamic climate regime and increasing human impacts. They stress how, historically, there have been strong and beneficial connections between people and ecosystems in this region. This is because societies have evolved and developed under continual climate change and, as a result, there is often an inbuilt societal resilience to climate change, offering important insights around ecosystem responses to climate change.

6. Conclusions

The contributions in this volume indicate that research into the origins and development of agriculture is a flourishing area of archaeological science. They show two major developments in the state of the art for research in Neolithic archaeology: i) refinement of knowledge derived from truly interdisciplinary detailed case studies, accompanied by a refinement of existing methods and the development and application of new techniques; ii) new approaches that facilitate the analysis of data on a regional to continental scale. In particular, increasing emphases upon truly interdisciplinary projects are yielding considerable understanding of the process of Neolithisation. In particular, several contributions in this volume (e.g. Feeser and Furholt, 2014; Mayle and Iriante, 2014; Woodbridge et al., 2014b) reveal the advantages of examining diverse lines of evidence alongside each other. This is part of a wider trend of synthesis currently occurring across several major Neolithic European projects (e.g. EUROEVOL, Shennan et al., 2013; Manning et al. 2013; AGRIWESTMED, Peña-Chocarro et al., 2013; The Domestication of Europe Project, Jones et al., 2013a; SPP1400: Early Monumentality and Social Differentiation, Müller, 2011a, 2011b; Müller et al., 2013; 'Cultivating Societies' Project, McClatchie et al., 2014; Whitehouse et al., 2014; 'Deforesting Europe' project, Woodbridge et al., 2014a, 2014b).

Many previous accounts concerning the origins and development of agro-pastoralism have emphasised the role of environmental or social change. The main challenge, of course, is obtaining suitable, sufficient, high quality data to test for correlations. The timing of cultural and environmental events is obviously crucial, but often the precision of many chronologies is insufficient for examining questions at the human-scale. This situation has changed in recent years through the use of Bayesian approaches to chronology (Buck et al. 1996; Bronk Ramsey, 2009), both in archaeological (e.g. Bayliss and Whittle, 2007; Whittle et al. 2011) and palaeoecological contexts (e.g. Blaauw et al. 2007). Advances in the development of spatio-temporal models and simulations currently enable the examination of sophisticated questions concerning the temporality and regionality of agricultural traditions and the role of migration and acculturation. The strong integration of archaeological and palaeoecological chronological approaches (Sørensen and Karg, 2014; Farrell et al., 2014; cf. Kirleis and Fischer, 2014) are a welcome development and signals an interdisciplinary approach that characterises an archaeological science that has achieved a maturity and criticality that was perhaps less evident even 5–10 years or so ago. Moreover, these strongly chronological approaches are facilitating significant knowledge advancement, and a growing appreciation for examining the archaeology of longer time-spans and wider geographic regions with the view to providing larger, integrated narratives. Such work is revealing that much research emphasis has been placed on the early stage of the transition to Neolithic agriculture, sometimes to the expense of a longer-term perspective (e.g. Whitehouse et al., 2014). Yet an understanding of longer periods has significant insights to bear upon how societies moved to an agricultural existence of surplus, this being a first critical step in the development of complex societies in later prehistory.

Longer narratives are also generating considerable interest from scholars in other fields, particularly environmental scientists and ecologists, who, in recent years have become increasingly concerned with Earth System Science. Thus, human activities over the last 10,000 years have led to land-use transformations that have driven major ecosystem changes such as deforestation, loss of ecosystem function and diversity, species decline and extinctions, increased soil runoff and localised flooding (e.g. Dreibrodt et al., 2010). This is especially the case since the advent of agriculture. Although many scientists are now appreciating the importance of human impacts on the Holocene landscape and its concurrent roles in shaping today's landscapes and its influence on the climate system, we have a very incomplete picture in terms of the intensities and rates at which landscapes underwent changes, the levels of human pressures on the landscape, how these varied across time and space, and the roles of humans and natural processes in reshaping our landscapes and ecosystems. For instance, human–environment interaction research has significant scientific value to studies that are concerned with land-use change and their relationship to Holocene carbon emissions (e.g. Kaplan et al., 2009, 2010). Answering these types of research questions will require greater efforts integrating the varied lines of archaeological, ecological and geographical evidence together, and are likely to yield significant scientific data of wide interest to the community. Environmental archaeologists, therefore, have a prime opportunity to engage with these debates and make important contributions to issues of significant modern societal relevance.

One theme that emerges from many of the papers concerns the maintenance of the agricultural system under uncertain conditions. It is clear that crop diversity during the European Neolithic was a key element in reducing risk and uncertainty in crop production and maintaining a sustainable agricultural system (cf. Marinova, 2014). This is also obvious from several contributions from other

parts of the world, notably areas such as SE Asia (Hunt and Rabbett, 2014), where the use of a variety of plant foods may have been associated with risk reduction and creating sustainable land management systems. The persistence of the use of wild taxa in many regions of Europe is interesting in this context and suggests that insights from other regions of the world can provide alternative explanations for the use of wild resources in areas that are relatively well-studied, such as Europe. Wild species are evident within many plant assemblages, especially within Britain and Ireland, but also elsewhere in central Europe (Bishop et al., 2009; Kirleis et al., 2012; Roehrs et al., 2013; McClatchie et al., 2014). However, the importance and persistence of wild animals is also becoming apparent. Schibler and Jacomet (2010) show that wild animals were are an important food source in Alpine areas during periods of climatic uncertainty, whilst Manning et al. (2013) argue that there are higher values of terrestrial wild animals in central Europe during the early stages of the LBK. There are geographic patterns to the exploitation of wild animals, with greater representation of wild species – dominated by hares and rabbit – at central and south-west Mediterranean sites, but especially so in south-eastern France (Manning et al., 2013). Why this should be the case is less clear but it would be interesting to explore these patterns in association with pollen and archaeobotanical records. In marginal areas across Atlantic Europe the first farming communities continued to diversify their food sources, especially during periods of resource shortages. In Neolithic Shetland, for instance, isotopic analysis of juvenile dentine indicates that marine foods were consumed on an occasional basis, perhaps forming supplementary resources during times of scarcity and when crops failed to yield good harvests (Montgomery et al., 2013). It is clear that early agriculturalists made use of a variety of food resources, alongside domesticated plants and animals – perhaps as a deliberate strategy to manage risk and periods of uncertainty.

In common with areas of SE Asia and New Guinea, it is also obvious that Neolithic groups in Europe were active agents in developing domesticated varieties and were not just passive 'receivers' of these. This is shown most clearly by recent genetic work that shows that several distinct lineages of some domesticated animals were developed in Europe, including cows and pigs. Schibler et al. (2014) report on archaeozoological and ancient genetic evidence for wild auroch being incorporated into a domestic cattle herd from a Neolithic lake-dwelling in Switzerland. In the case of pig, genetic work indicates that European local wild boar types went on to become the dominant haplotype in prehistoric Europe, replacing animals from the Near East that had travelled to Europe during the early Neolithic (Larson et al., 2007). This should not come as a surprise, since hunter-gatherers were skillful harvesters and processors of wild grasses, plants and animals well before the advent of domestication (e.g. Aranguren et al., 2007; Nadel et al., 2012; Willcox and Stordeur, 2012) and in some cases clearly managed animals – for example, wild boar – in the pre-Neolithic period (e.g. Vigne et al., 2009). These examples serve to emphasise that the continuing dichotomy between labelling groups 'agriculturalists' or 'hunter-gatherers' is unhelpful (cf. Harris, 1989), obscures many aspects of a continuum of complex human behaviour around the emergence of agriculture and builds up inherent assumptions that come with such labels.

Finally, environmental archaeology has an opportunity to help guide our understanding of sustainable and resilient agriculture, in diverse areas of the world. As Gillson and Marchant (2014) point out, we have at our disposal historical archives, archaeological and palaeoecological records to help us understand the natural range of variability, and the resilience of socio-ecological activities to past changes in climate, disturbance, and land use. These, combined with an archaeological understanding of social interaction in the past may serve as a strong tool to approach some of the most pressing problems in our modern, warming world, like food security and human adaptation to climate change (IPCC report, 2013). Archaeologists have much to contribute to these issues, using their knowledge from the past, to help manage and contribute solutions towards how we address these problems, both in the present and the future.

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References

Aranguren, B., Becattini, R., Lippi, M.M., Revedin, A., 2007. Grinding flour in Upper Palaeolithic Europe (25000 years BP). Antiquity 81, 845–855.
Bakels, C., 2014. The first farmers of the Northwest European Plain: some remarks on their crops, crop cultivation and impact on the environment. J. Archaeol. Sci. 51, 94–97.
Bakker, J.A., Bloo, S.B.C., Dütting, M.K. (Eds.), 2013. From Funeral Monuments to Household Pottery. Current Advances in Funnel Beaker Culture (TRB/TBK) Research (Proceedings of the Borger Meetings 2009, The Netherlands). Oxbow Books, Oxford.
Bakker, J.A., Kruk, J., Lanting, A.E., Milisauskas, S., 1999. The earliest evidence of wheeled vehicles in Europe and the Near East. Antiquity 73, 778–790.
Barker, G., 2006. The Agricultural Revolution in Prehistory. Oxford University Press, USA.
Bayliss, A., Whittle, A., 2007. Histories of the dead: building chronologies for five southern British long barrows. Camb. Archaeol. J. 17 (Suppl. 1), 1–147.
Bellwood, P., 2005. First Farmers. The Origins of Agricultural Societies. Blackwell, Malden (MA).
Bishop, R.R., Church, M.J., Rowley-Conwy, P.A., 2009. Cereals, fruits and nuts in the Scottish Neolithic. Proc. Soc. Antiq. Scotl. 139, 47–103.
Blaauw, M., Bakker, R., Christen, J.A., Hall, V.A., van der Plicht, J., 2007. A Bayesian framework for age-modelling of radiocarbon-dated peat deposits: case studies from the Netherlands. Radiocarbon 49, 357–367.
Bogaard, A., 2004. Neolithic Farming in Central Europe. Routledge, London.
Bogaard, A., Jones, G., 2007. Neolithic farming in Britain and central Europe: contrast or continuity? Proc. Br. Acad. 144, 357–375.
Bogaard, A., Heaton, T.H.E., Poulton, P., Merbach, I., 2007. The impact of manuring on nitrogen isotope ratios in cereals: archaeological implications for reconstruction of diet and crop management practices. J. Archaeol. Sci. 34, 335–343.
Bogaard, A., Krause, R., Strien, H.-C., 2011. Towards a social geography of cultivation and plant use in an early farming community: Vaihingen an der Enz, south-west Germany. Antiquity 85, 395–416.
Bronk-Ramsey, C., 2009. Bayesian analysis of radiocarbon dates. Radiocarbon 51, 337–360.
Brown, A., 2007. Dating the onset of cereal cultivation in Britain and Ireland: the evidence from charred cereal grains. Antiquity 81, 1042–1052.
Brozio, J.P., Dörfler, W., Feeser, I., Kirleis, W., Klooß, S., Müller, J., 2014. A Middle Neolithic well from Northern Germany: a precise source to reconstruct water supply management, subsistence economy, and deposition practices. J. Archaeol. Sci. 51, 135–153.
Buck, C.E., Cavanagh, W.G., Litton, C.D., 1996. Bayesian Approach to Interpreting Archaeological Data. John Wiley & Son, Chichester.
Carson, J.F., Whitney, B.S., Mayle, F.E., Iriarte, J., Prümers, H., Soto, J.D., Watling, J., 2014. Environmental impact of geometric earthwork construction in pre-Columbian Amazonia. Proc. Natl. Acad. Sci. http://dx.doi.org/10.1073/pnas.1321770111.
Colledge, S.J., Conolly, J., Shennan, S., 2005. The evolution of Neolithic farming from SW Asian origins to NW European limits. Eur. J. Archaeol. 8, 137–156.
Conolly, J., Colledge, S., Shennan, S., 2008. Founder effect, drift, and adaptive change in domestic crop use in early Neolithic Europe. J. Archaeol. Sci. 35, 2797–2804.
Cramp, L.J.E., Jones, J., Sheridan, A., Smyth, J., Whelton, H., Mulville, J., Sharples, N., Evershed, R.P., 2014. Immediate replacement of fishing with dairying by the earliest farmers of the northeast Atlantic archipelagos. Proc. R. Soc. B 281. http://dx.doi.org/10.1098/rspb.2013.2372.
Crombé, P., Robinson, E., 2014. ^{14}C dates as demographic proxies in neolithisation models of northwestern Europe: a critical assessment using Belgium and northeast France as a case-study. J. Archaeol. Sci. http://dx.doi.org/10.1016/j.jas.2014.02.001.

Denevan, W.M., 2003. Cultivated Landscapes of Native Amazonia and the Andes. Oxford University Press, Oxford.

Denham, T., 2007. Early agriculture: recent conceptual and methodological developments. In: Denham, T., White, P. (Eds.), The Emergence of Agriculture; a Global View. Routledge, London, pp. 1–25.

Denham, T., 2013. Early farming in Island Southeast Asia: an alternative hypothesis. Antiquity 87, 250–257.

Denham, T., Iriarte, J., Vrydaghs, L. (Eds.), 2009. Rethinking Agriculture: Archaeological and Ethnoarchaeological Perspectives. Left Coast Press, Walnut Creek, Calif.

Dörfler, W., Feeser, I., Van den Bogaard, C., Dreibrodt, S., Erlenkeuser, H., Kleinmann, A., Merkt, J., Wiethold, J., 2012. A high-quality annually laminated sequence from Lake Belau, northern Germany: revised chronology and its implications for palynological and tephrochronological studies. Holocene 22, 413–426.

Dreibrodt, S., Lubos, C., Terhorst, B., Damm, B., Bork, H.-R., 2010. Historical soil erosion by water in Germany: scales and archives, chronology, research perspectives. Quat. Int. 222, 80–95.

Dreibrodt, S., Zahrer, J., Bork, H.-R., Brauer, A., 2012. Witterungs- und Umweltgeschichte während der norddeutschen Trichterbecherkultur – rekonstruiert auf Basis mikrofazieller Untersuchungen an jahresgeschichteten Seesedimenten. In: Hinz, M., Müller, J. (Eds.), Siedlung, Grabenwerk, Großsteingrab. Studien zu Gesellschaft, Wirtschaft und Umwelt der Trichterbechergruppen im nördlichen Mitteleuropa. Frühe Monumentalität und soziale Differenzierung 2, Habelt, Bonn, pp. 145–158.

Ellis, E.C., Kaplan, J.O., Fuller, D.Q., Vavrus, S., Goldewijk, K.K., Verburg, P.H., 2013. Used planet: a global history. Proc. Natl. Acad. Sci. 110, 7978–7985.

Fairbairn, A., 2005. An archaeobotanical perspective on Holocene plant-use practices in lowland northern New Guinea. World Archaeol. 37, 487–502.

Farrell, M., Bunting, M.J., Lee, D.H.J., Thomas, A., 2014. Neolithic settlement at the woodlands edge: palynological data and timber architecture in Orkney, Scotland. J. Archaeol. Sci. 51, 225–236.

Feeser, I., Furholt, M., 2014. Ritual and economic activity during the Neolithic in Schleswig-Holstein, northern Germany: an approach to combine archaeological and palynological evidence. J. Archaeol. Sci. 51, 126–134.

Feeser, I., Dörfler, W., Averdieck, F.-R., Wiethold, J., 2012. New insight into regional and local land-use and vegetation patterns in eastern Schleswig-Holstein during the Neolithic. In: Hinz, M., Müller, J. (Eds.), Siedlung, Grabenwerk, Großsteingrab. Studien zu Gesellschaft, Wirtschaft und Umwelt der Trichterbechergruppen im nördlichen Mitteleuropa. Frühe Monumentalität und soziale Differenzierung 2, Habelt, Bonn, pp. 159–190.

Fraser, R., Bogaard, A., Heaton, T., Charles, M., Jones, G., Christensen, B.T., Halstead, P., Merbach, I., Poulton, P.R., Sparkes, D., Styring, A.K., 2011. Manuring and stable nitrogen isotope ratios in cereals and pulses: towards a new archaeobotanical approach to the inference of land use and dietary practices. J. Archaeol. Sci. 38, 2790–2804.

Gillson, L., Marchant, R., 2014. From myopia to clarity: sharpening the focus of ecosystem management through the lens of palaeoecology. Trends Ecol. Evol. 29, 317–325.

Glørstad, H., 2010. The Structure and History of the Late Mesolithic Societies in the Oslo Fjord Area 6300–3800 BC. Bricoleur Press, Lindome.

Gronenborn, D., Strien, H.-C., Dietrich, S., Sirocko, F., 2014. "Adaptive cycles" and climate fluctuations – a case study from linear pottery culture in western Central Europe. J. Archaeol. Sci. 51, 73–83.

Grove, A.T., Rackham, O., 2001. The Nature of Mediterranean Europe. An Ecological History. Yale University Press, Yale.

Harris, D.R., 1989. An evolutionary continuum of people–plant interaction. In: Harris, D.R., Hillman, G.C. (Eds.), Foraging and Farming: the Evolution of Plant Exploitation. Unwin Hyman, London, pp. 11–26.

Hinz, M., Feeser, I., Sjögren, K.G., Müller, J., 2012. Demography and the intensity of cultural activities: an evaluation of Funnel Breaker Societies (4200–2800 cal BC). J. Archaeol. Sci. 39, 3331–3340.

Horak, J., Vodka, S., Kout, J., Halda, J.P., Bogusch, P., Pech, P., 2014. Biodiversity of most dead wood-dependent organisms in thermophilic temperate oak woodlands thrives on diversity of open landscape structures. For. Ecol. Manag. 315, 80–85.

Huisman, D.J., Raemaekers, D.C.M., 2014. Systematic cultivation of the Swifterbant wetlands (The Netherlands). Evidence from Neolithic tillage marks (c. 4300–4000 cal. BC). J. Archaeol. Sci. 49, 572–584.

Hunt, C., Rabbett, R.J., 2014. Holocene landscape intervention and plant food production strategies in island and mainland Southeast Asia. J. Archaeol. Sci. 51, 22–33.

IPCC, 2013. Climate Change 2013: the Physical Science Basis. http://www.ipcc.ch/report/ar5/wg1/.

Jansen, D., Nelle, O., 2014. The Neolithic woodland – Archaeoanthracology of six Funnel Beaker sites in the lowlands of Germany. J. Archaeol. Sci. 51, 154–163.

Jin, G., Wang, C., Liu, Y., Zhang, K., Wang, Z., 2014. 8000-year old rice remains from the north edge of the Shandong Highlands, East China. J. Archaeol. Sci. 51, 34–42.

Jones, G., 2000. Evaluating the importance of cultivation and collecting in Neolithic Britain. In: Fairbairn, A.S. (Ed.), Plants in Neolithic Britain and beyond. Oxbow, Oxford, pp. 79–84.

Jones, G., Jones, H., Charles, M.P., Jones, M.K., Colledge, S., Leigh, F.J., Lister, D., Smith, L.M.J., Powell, W., Brown, T., 2012. Phylogeographic analysis of barley DNA as evidence for the spread of Neolithic agriculture through Europe. J. Archaeol. Sci. 39, 3230–3238.

Jones, G., Charles, M.P., Jones, M.K., Colledge, S., Leigh, F.J., Lister, D.A., Smith, L.M.J., Powell, W., Brown, T.A., Jones, H., 2013a. DNA evidence for multiple introductions of barley into Europe following dispersed domestications in Western Asia. Antiquity 87, 701–713.

Jones, S.E., Hunt, C.O., Barton, H., Lentfer, C.J., Reimer, P.J., 2013b. Forest disturbance, arboriculture and the adoption of rice in the Kelabit Highlands of Sarawak, Malaysian Borneo. Holocene 23, 1528–1546.

Kanstrup, M., Holst, M.K., Jensen, P.M., Thomsen, I., Christensen, B.T., 2014. Searching for long-term trends in prehistoric manuring practice. d15N analyses of charred cereal grains from the 4th to the 1st millennium BC. J. Archaeol. Sci. 51, 115–125.

Kaplan, J.O., Krumhardt, K.M., Zimmermann, N., 2009. The prehistoric and preindustrial deforestation of Europe. Quat. Sci. Rev. 28, 3016–3034.

Kaplan, J.O., Krumhardt, K.M., Ellis, E.C., Ruddiman, W.F., Lemmen, C., Goldewijk, K.K., 2010. Holocene carbon emissions as a result of anthropogenic land cover change. Holocene 21, 775–791.

Kirleis, W., Fischer, E., 2014. Neolithic cultivation of tetraploid free threshing wheat in Denmark and northern Germany: implications for crop diversity and societal dynamics of the Funnel Beaker Culture. Veg. Hist. Archaeobot. 23 (Suppl.), S81–S96. http://dx.doi.org/10.1007/s00334-014-0440-8.

Kirleis, W., Klooß, S., Kroll, H., Müller, J., 2012. Crop growing and gathering in the northern German Neolithic: a review supplemented by first new results. Veg. Hist. Archaeobot. 21, 221–242.

Krause-Kyora, B., Makarewicz, C., Evin, A., Girdland Flink, L., Dobney, K., Larson, G., Hartz, S., Schreiber, S., von Carnap-Bornheim, C., von Wurmb-Schwark, N., Nebel, A., 2013. Use of domesticated pigs by Mesolithic hunter-gatherers in northwestern Europe. Nat. Commun. 4, 2348. http://dx.doi.org/10.1038/ncomms3348.

Kreuz, A., 2012. Die Vertreibung aus dem Paradies? Archäobiologische Ergebnisse zum Frühneolithikum im westlichen Mitteleuropa. Berichte RGK 91, 23–196.

Kreuz, A., Marinova, E., Schäfer, E., Wiethold, J., 2005. A comparison of early Neolithic crop and weed assemblages from the Linearbandkeramik and the Bulgarian Neolithic cultures: differences and similarities. Veg. Hist. Archaeobot. 14, 237–258.

Larson, G., Albarella, U., Dobney, K., Rowley-Conwy, P., Schibler, J., Tresset, A., Vigne, J.-D., Edwards, C.J., 2007. Ancient DNA, pig domestication, and the spread of the Neolithic into Europe. Proc. Natl. Acad. Sci. 104, 15276–15281.

Lee, E., Renneberg, R., Harder, M., Krause-Kyora, B., Rinne, C., Müller, J., Nebel, A., von Wurmb-Schwark, N., 2014. Collective burials among agro-pastoral societies in later Neolithic Germany: perspectives from ancient DNA. J. Archaeol. Sci. 51, 174–180.

Lemmen, C., Wirtz, K.W., 2014. On the sensitivity of the simulated Neolithic transition in Europe to climate extremes. J. Archaeol. Sci. 51, 65–72.

Manning, K., Downey, S.S., Colledge, S., Conolly, J., Stopp, B., Dobney, K., Shennan, S., 2013. The origins and spread of stock-keeping: the role of cultural and environmental influences on early Neolithic animal exploitation in Europe. Antiquity 87 (338), 1046–1059.

Marchant, R., Lane, P., 2014. Past perspectives for the future: foundations for sustainable development in East Africa. J. Archaeol. Sci. 51, 12–21.

Marinova, E., 2014. Crop diversity through time: introduction. In: Chevalier, A., Marinova, E., Peña-Chocarro, L. (Eds.), Plant and People; Choices and Diversity through Time. Oxbow Books, Oxford & Philadelphia, pp. 61–63.

Mayle, F.E., Iriarte, J., 2014. Integrated palaeoecology and archaeology: a powerful approach for understanding pre-Columbian Amazonia. J. Archaeol. Sci. 51, 54–64.

McClatchie, M., Bogaard, A., Colledge, S., Whitehouse, N.J., Schulting, R.J., Barratt, P., McLaughlin, R., 2014. Neolithic farming in north-western Europe: archaeobotanical evidence from Ireland. J. Archaeol. Sci. 51, 206–215.

McLaughlin, T.R., Whitehouse, N.J., Schulting, R.J., McClatchie, M., Barratt, P., Bogaard, A., September 2014. A time and a place for everything: an overview of the settlement and burial record of Neolithic and Early Bronze Age Ireland. J. Anthropol. Archaeol. (submitted for publication).

McMichael, C., Palace, M.W., Bush, M.B., Braswell, R., Hagen, S., Neves, E., Silman, M.R., Tamanha, E., Czarnecki, C., 2014. Predicting pre-Columbian anthropogenic soils in western Amazonia. Proc. R. Soc. B 281 (1777). http://dx.doi.org/10.1098/rspb.2013.2475.

Mischka, D., 2013. Die sozioökonomische Bedeutung von Pflugspuren im Frühneolithikum des nördlichen Mitteleuropas. In: Heske, I., et al. (Eds.), Landschaft, Besiedlung und Siedlung. Archäologische Studien im nordeuropäischen Kontext. Festschrift Willroth, Wachholtz, Neumünster, pp. 295–306.

Moffett, L., Robinson, M.A., Straker, V., 1989. Cereals, fruit and nuts: charred plant remains from Neolithic sites in England and Wales and the Neolithic economy. In: Milles, A., Williams, D., Gardner, N. (Eds.), The Beginnings of Agriculture, British Archaeological Reports International Series 496. British Archaeological Reports, Oxford, pp. 243–261.

Montgomery, J., Jay, M., Keefe, M., Gledhill, A.R., Cook, G.T., Dockrill, S.J., Melton, N.D., 2013. Strategic and sporadic marine consumption at the onset of the Neolithic: increasing temporal resolution in the isotope evidence. Antiquity 87, 1060–1072.

Müller, J., 2011a. Ritual cooperation and ritual collectivity: the social structure of the middle and younger Funnel Beaker North Group (3500–2800 BC). In: Furholt, M., Lüth, F., Müller, J. (Eds.), Megaliths and Identities. Early Monuments and Neolithic Societies from the Atlantic to the Baltic. Habelt, Bonn, pp. 273–284.
Müller, J., 2011b. Megaliths and Funnel Beakers: Societies in Change, 4100–2700 BC. In: Kroon-Voordracht. Stichting Nederlands Museum voor Anthropologie en Praehistorie, Amsterdam.
Müller, J., Bork, H.R., Brozio, J.P., Demnick, D., Diers, S., Dibbern, H., Dörfler, W., Feeser, I., Fritsch, B., Furholt, M., Hage, F., Hinz, M., Kirleis, W., Klooß, S., Kroll, H., Lorenz, M.L.L., Mischka, D., Rinne, C., 2013. Landscapes as social spaces and ritual meaning: some new results on TRB in northern Germany. In: Bakker, J.A., Bloo, S.B.C., Dütting, M.K. (Eds.), From Funeral Monuments to Household Pottery. Current Advances in Funnel Beaker Culture (TRB/TBK) Research (Proceedings of the Borger Meetings 2009, The Netherlands). Oxbow Books, Oxford, pp. 51–80.
Nadel, D., Piperno, D.R., Holst, I., Snir, A., Weiss, E., 2012. New evidence for the processing of wild cereal grains at Ohalo II, a 23 000-year-old campsite on the shore of the Sea of Galilee, Israel. Antiquity 86, 990–1003.
Nielsen, A.B., Odgaard, B.V., 2010. Quantitative landscape dynamics in Denmark through the last three millennia based on the Landscape Reconstruction Algorithm approach. Veg. Hist. Archaeobot. 19, 375–387.
Pelling, R., Campbell, G., 2013. Plant resources. In: Canti, M., Campbell, G., Greaney, S. (Eds.), Stonehenge World Heritage Site Synthesis: Prehistoric Landscape, Environment and Economy. English Heritage, Fort Cumberland, Portsmouth, pp. 37–60.
Peña-Chocarro, L., Pérez Jordà, G., Mateos, J.M., Zapata, L.M., 2013. Neolithic plant usage in the Western Mediterranean region: preliminary results from the AGRIWESTMED project. Ann. Bot. (Roma) 3, 135–141.
Rasmussen, P., 2005. Mid- to late-Holocene land-use change and lake development at Dallund Sø, Denmark: vegetation and land-use history inferred from pollen data. Holocene 15, 1116–1129.
Robinson, M.A., 2000. Further consideration of Neolithic charred cereals, fruits and nuts. In: Fairbairn, A. (Ed.), Plants in Neolithic Britain and Beyond. (Neolithic Studies Group Seminar Papers 5). Oxbow Books, Oxford, pp. 85–90.
Roehrs, H., Klooss, S., Kirleis, W., 2013. Evaluating prehistoric finds of *Arrhenatherum elatius* var. *bulbosum* in North-western and Central Europe with emphasis on the first Neolithic finds in Northern Germany. J. Archaeol. Anthropol. Sci. 5, 1–15.
Rösch, M., Kleinmann, A., Lechterbeck, J., Wick, L., 2014. Botanical off-site and on-site data as indicators of different land use systems: a discussion with examples from Southwest Germany. Veg. Hist. Archaeobot. 23 (Suppl.), S121–S133.
Rowley-Conwy, P., 2004. How the West was lost: a reconsideration of agricultural origins in Britain, Ireland, and Southern Scandinavia. Curr. Anthropol. 45, S83–S113.
Rowley-Conwy, P., 2011. The spread of agriculture from Central Europe to the Atlantic. Curr. Anthropol. 52 (Suppl. 4), S431–S451.
Sadovnik, M., Robin, V., Nadeau, M.J., Bork, H.-R., Nelle, O., 2014. Neolithic human impact on landscapes related to megalithic structures: palaeoecological evidence from the Krähenberg, northern Germany. J. Archaeol. Sci. 51, 164–173.
Salavert, A., 2011. Plant economy of the first farmers of central Belgium (Linearbandkeramik, 5200–5000 B.C.). Veg. Hist. Archaeobot. 20, 321–332.
Salavert, A., Bosquet, D., Damblon, F., 2014. Natural woodland composition and vegetation dynamic during the Linearbandkeramik in north-western Europe (central Belgium, 5200–5000 B.C.). J. Archaeol. Sci. 51, 84–93.
Saqalli, M., Salavert, A., Bréhard, S., Bendrey, R., Vigne, J.-D., Tresset, A., 2014. Revisiting and modelling the woodland farming system of the early Neolithic Linear Pottery Culture (LBK), 5600–4900 B.C. Veg. Hist. Archaeobot. 23 (Suppl.), S37–S50.
Schaan, D.P., 2012. Sacred Geographies of Ancient Amazonia; Historical Ecology of Social Complexity. Walnut Creek, California.
Schibler, J., Jacomet, S., 2010. Short climatic fluctuations and their impact on human economies and societies: the potential of Neolithic lake shore settlements in the Alpine foreland. Environ. Archaeol. 15, 61–70.
Schibler, J., Elsner, J., Schlumbaum, A., 2014. Incorporation of aurochs into a cattle herd in Neolithic Europe: single event or breeding? Nat. Sci. Rep. 4, 5798. http://dx.doi.org/10.1038/srep05798.
Schier, W., 2009. Extensiver Brandfeldbau und die Ausbreitung der neolithischen Wirtschaftsweise in Mitteleuropa und Südskandinavien am Ende des 5. Jahrtausends V. Chr. Prähist. Z. 84, 15–43.
Schlichtherle, H., 2002. Die jungsteinzeitlichen Radfunde vom Federsee und ihre kulturgeschichtliche Bedeutung. Janus-Verlag, Freiburg i. Br, pp. 9–34.
Schlumbaum, A., van Glabeke, S., Roldan-Ruiz, I., 2011. Towards the onset of fruit tree growing north of the Alps: ancient DNA from waterlogged apple (*Malus* sp.) seed fragments. Ann. Anat. 194, 157–162.
Schulting, R.J., Richards, M.P., 2002. The wet, the wild and the domesticated: the Mesolithic–Neolithic transition on the west coast of Scotland. Eur. J. Archaeol. 5, 147–189.
Schulting, R., Sheridan, A., Crozier, R., Murphy, E., 2010. Revisiting Quanterness: new AMS dates and stable isotope data from an Orcadian chamber tomb. Proc. Soc. Antiq. Scotl. 140, 1–50.
Seddon, A., Mackay, A., Baker, A., Birks, H.J.B., Breman, E., Buck, C., Ellis, E.C., Froyd, C.A., Gill, J., Gillson, L., Johnson, E., Jones, V., Juggins, S., Macia-Fauria, M., Mills, K., Morris, J.L., Nogués-Bravo, D., Punyasena, S., Roland, T., Tanentzap, A., Willis, K., Aberhan, M., van Asperen, E.N., Austin, W., Battarbee, R.W., Bhagwat, S., Belanger, C.L., Bennett, K.D., Birks, H.H., Bronk Ramsey, C., Brooks, S., de Bruyn, M., Butler, P.G., Chambers, F.M., Clarke, S., Davies, A.L., Dearing, J.A., Ezard, T.H.G., Feudean, A., Flower, R.J., Gell, P., Hausmann, S., Hogan, E.J., Hopkins, M.J., Jeffers, E.S., Korhola, A.A., Marchant, R., Kiefer, T., Lamentowicz, M., Larocque-Tobler, I., Lopes-Merino, L., Hsiang Liow, L., McGowan, S., Miller, J.H., Montoya, E., Morton, O., Nogué, S., Onoufriou, C., Park Boush, L., Rodriguez-Sanchez, F., Rose, N.L., Sayer, C.D., Shaw, H.E., Payne, R., Simpson, G., Sohar, K., Whitehouse, N.J., Williams, J.W., Witkowski, A., 2014. Looking forward through the past. Identification of fifty priority research questions in palaeoecology. J. Ecol. 102, 256–267.
Shennan, S., Conolly, J., 2007. The Origin and Spread of Neolithic Plant Economies in the Near East and Europe. Available at: http://ads.ahds.ac.uk/catalogue/archive/neoplants_ahrb_2005/index.cfm (last accessed 06.12.10.).
Shennan, S., Downey, S.S., Timpson, A., Edinborough, K., Colledge, S., Kerig, T., Manning, K., Thomas, M.G., 2013. Regional population collapse followed initial agriculture booms in mid-Holocene Europe. Nat. Commun. 4, 2486. http://dx.doi.org/10.1038/ncomms3486.
Smyth, J., 2010. The house and group identity in the Irish Neolithic. Proc. R. Ir. Acad. C 111, 1–31.
Sørensen, L., Karg, S., 2014. The expansion of agrarian societies towards the North – new evidence for agriculture during the Mesolithic/Neolithic transition in Southern Scandinavia. J. Archaeol. Sci. 51, 98–114.
Spriggs, M., 2011. Archaeology and the Austronesian expansion: where are we now? Antiquity 85, 510–525.
Stevens, J.C., Fuller, D.Q., 2012. Did Neolithic farming fail? The case for a Bronze Age agricultural revolution in the British Isles. Antiquity 86, 707–722.
Sugita, S., 2007. Theory of quantitative reconstruction of vegetation I: pollen of large sites reveals regional vegetation composition. Holocene 17, 229–241.
Summerhayes, G.R., Leavesley, M., Fairbairn, A., Mandui, H., Field, J., Fullagar, R., 2010. Human adaptation and plant use in Highland New Guinea 49,000 to 44,000 years ago. Science 330 (6000), 78–81.
Tallavaara, M., Seppä, H., 2012. Did the mid-Holocene environmental changes cause the boom and bust of hunter-gatherer population size in eastern Fennoscandia? Holocene 22, 215–225.
Thomas, J., 1999. Understanding the Neolithic. Routledge, London.
Thomas, J., 2004. Current debates on the Mesolithic–Neolithic transition in Britain and Ireland. Doc. Praehist. 31, 113–130.
Tresset, A., Vigne, J.-D., 2007. Substitution of species, techniques and symbols at the Mesolithic–Neolithic transition in western Europe. Proc. Br. Acad. 144, 189–210.
Vigne, J.-D., Zazzo, A., Saliege, J.-F., Poplin, F., Guilaine, J., Simmons, A., 2009. Pre-Neolithic wild boar management and introduction to Cyprus more than 11,400 years ago. Proc. Natl. Acad. Sci. 106, 16135–16138.
Weisskopf, A., Fuller, D., Kingwell-Banham, E., Kajale, M., Mohante, R., 2014. Archaeobotanical implications of phytolith assemblages from cultivated rice systems, wild rice stands and macro-regional patterns. J. Archaeol. Sci. 51, 43–53.
Whitehouse, N.J., Smith, D., 2010. How fragmented was the British Holocene wildwood? Perspectives on the “Vera” grazing debate from the fossil beetle record. Quat. Sci. Rev. 29, 539–553.
Whitehouse, N.J., Schulting, R.J., McClatchie, M., Barratt, P.R., McLaughlin, R., Bogaard, A., Colledge, S., Marchant, R., Gaffrey, G., Bunting, M.J., 2014. Neolithic agriculture on the European western frontier: the boom and bust of early farming in Ireland. J. Archaeol. Sci. 51, 181–205.
Whittle, A., Healy, F., Bayliss, A. (Eds.), 2011. Gathering Time: Dating the Early Neolithic Enclosures of Southern Britain and Ireland. Oxbow, Oxford.
Wieckowska-Lüth, M., Dörfler, W., Kirleis, W., 2014. Early farming in southern Norway: pollen analytical investigations at Lake Skogtjern, Bamble (Telemark). In: Persson, P. (Ed.), Vestfoldbanprosjektet. Arkeologiske utgravninger i Porsgrunn kommune, Telemark fylke og Larvik kommune, Vestfold fylke. Aarsrap-port, Oslo (in press).
Willcox, G., Stordeur, D., 2012. Large-scale cereal processing before domestication during the tenth millennium cal BC in northern Syria. Antiquity 86, 99–114.
Willerding, U., 1986. Zur Geschichte der Unkräuter Mitteleuropas. Wachholtz Verlag, Neumünster.
Willis, K.J., Birks, H.J.B., 2006. What is natural? The need for a long-term perspective in biodiversity conservation. Science 314, 1261–1265.
Woodbridge, J., Fyfe, R.M., Roberts, N., 2014a. A comparison of remote-sensed and pollen-based approaches to mapping Europe's land cover. J. Biogeogr. 51, 216–224.
Woodbridge, J., Fyfe, R.M., Roberts, N., Downey, S., Edinborough, K., Shennan, S., 2014b. The impact of the Neolithic agricultural transition in Britain: a comparison of pollen based land cover based on archaeological ^{14}C date-inferred population change. J. Archaeol. Sci. 51, 216–224.

Zvelebil, M., 1996. The agricultural frontier and the transition to farming in the circum-Baltic region. In: Harris, D.R. (Ed.), The Origins and Spread of Agriculture and Pastoralism in Eurasia. University College London Press, London, pp. 323–345.
Zvelebil, M., 1998. Agricultural frontiers, Neolithic origins, and the transition to farming in the Baltic basin. In: Zvelebil, M., Domanska, L., Dennell, R. (Eds.), Harvesting the Sea, Farming the Forest: the Emergence of Neolithic Societies in the Baltic Region, Sheffield Archaeological Monographs, vol. 10. Sheffield Academic Press, Sheffield, pp. 9–27.
Zvelebil, M., 2005. Looking back at the Neolithic transition in Europe. Eur. J. Archaeol. 8, 183–194.